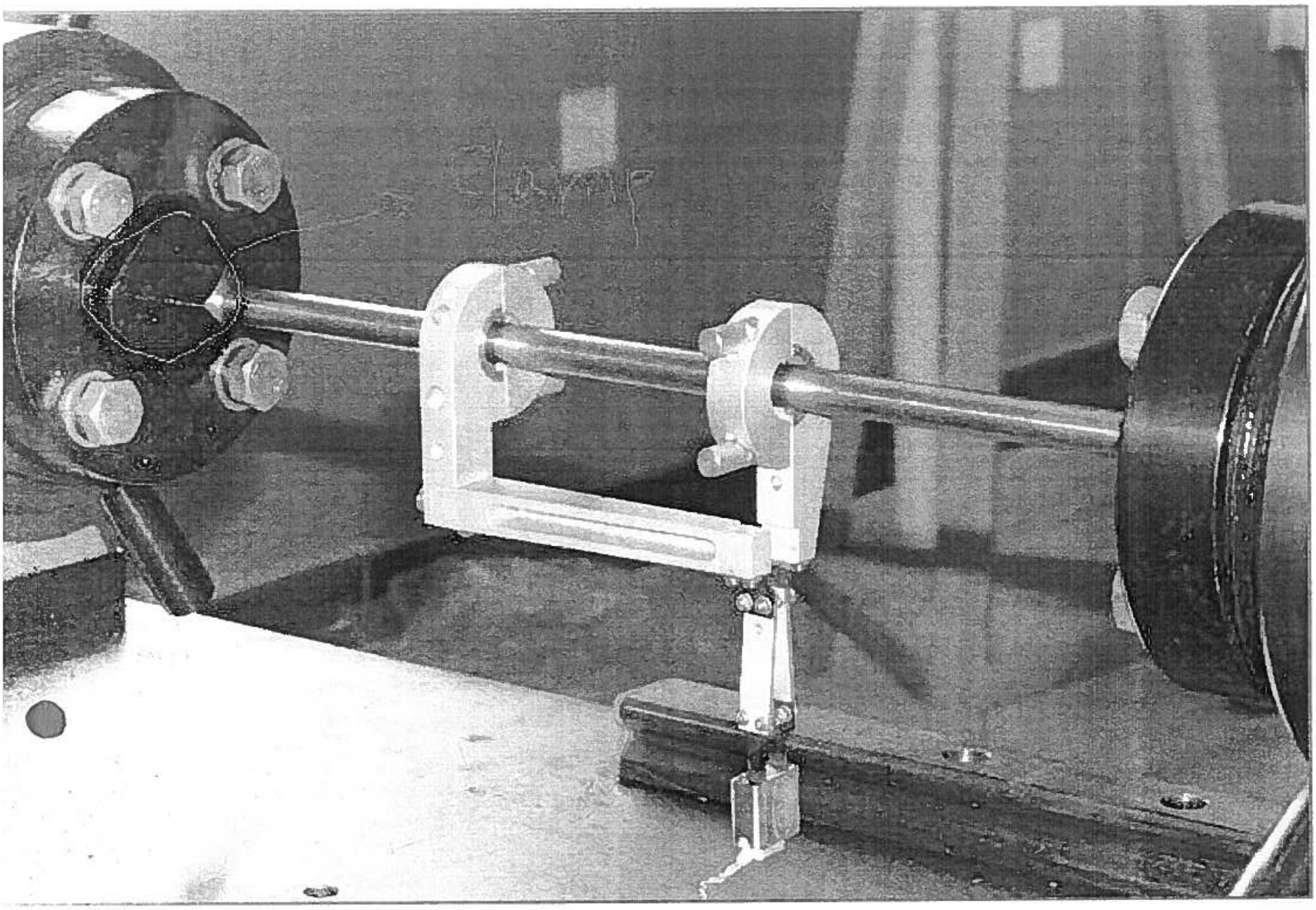


Metallic Materials--- Torsion Test at Ambient Temperature

1. Scope

This criterion fixes the terminology, sign, theory, sample, equipment, property measurement, the rounding off of numbers got from the measurement, and test report of metallic materials--- torsion test at ambient temperature.

This criterion is used for the measurement of torsion mechanics property at ambient temperature.

2. Normative Reference

Through citing, the clauses in the following documents are regarded as the clauses in our criterion. As for all the dated references, the adjustment (not including the wrong content) or revised edition are not suitable for this criterion. However, we encourage all parties of this criterion to make a research on whether they can use the latest version or not. For undated references, the latest edition of the normative document referred to applies.

GB/T 8170 Rounding

GB/T 10623 Mechanics Property Test Terminology of Metal Material

JJG 269 torsion test machine

3. Theory

Exerting torque on the sample and measuring the torque and its relevant torsion angle. We generally twist it off in order to measure one or more property of torsion mechanics that are defined on this criterion.

4. Terminology, definition and sign.

4.1 terminology and definition

The terminologies in GB/T 10623 and the following terminologies and definitions are suitable for this criterion.

4.1.1 Gauge length

L_o

It is used to measure the distance between two torsion markers on the sample.

4.1.2 Troptometer gauge length

L_e

The distance of parallel section when we use a torsion meter to measure the sample's torsional angle.

4.1.3 Maximum torque

T_m

After the yielding stage, the sample can stand the maximum torque. As for the metal material lacking of obvious yielding (successive yielding), it refers to the maximum torque during the experiment.

4.1.4 Shcar modulus

G

In the scope of forming the liner proportion, it refers to the proportion between shearing stress and shearing strain.

4.1.5

Proof strength of non-proportional torsion

τ_p

Is the shear stress when the non-proportional shear strain on the outer surface of the gauge part of the sample reaches the specified value during the torsion test.

Note: The symbol that represents this stress should be indicated by footnotes, for example, $\tau_{p0.015}$ and $\tau_{p0.3}$ represents that the specified non-proportional shear strain reaches 0.015% and 0.3% of the shear stress respectively.

4.1.6

Yield strength

If the metal material presents the yield phenomenon, on the stress point where plastic change reaches but the torsion does not increase during the test, upper yield strength and lower yield strength should be distinguished.

4.1.6.1

Upper yield strength

τ_{eH}

Is the highest shear stress before the torsion drops for the first time that the sample happens yield during the torsion test.

4.1.6.2

Lower yield strength

τ_{eL}

Is the lowest shear stress when the initial transient effect is not considered during the yield period in the torsion test.

4.1.7

Torsional strength τ_m

Is the shear stress corresponding to the maximum torsion.

4.1.8

Maximum non-proportional shear strain

γ_{max}

Is the maximum non-proportional shear strain on the sample's outer surface when it is twisted off.

Note: τ_p, τ_{eH}, τ_{eL} and τ_m are calculated via the elastic torsion formula. If the plasticity is considered, the formulas used below will be different.

4.2

Symbols

For symbols, names and units, see Table 1.

Table 1 Symbols, names and units

Symbol	Name	Unit
a	Wall thickness of the part of the tubular sample with parallel length	mm
d	Outer diameter of the part of the cylindrical sample with parallel length	mm
L_c	The sample's parallel length	mm
L_g	The sample's gauge length	mm
L_e	The torsion meter's gauge length	mm
L	Total length of the sample	mm
R	Transitional radius of the sample end	mm
T	Torsion	N·mm
Tp	Proof non-proportional torsion (The footnotes for the measured stress should be attached in the test records or the test report, for example $T_{p0.015}$ and $T_{p0.3}$ etc.)	N·mm

Table 1 (Continued)

Symbol	Name	Unit
T_{eH}	Upper yield torsion	N·mm
T_{eL}	Lower yield torsion	N·mm
T_m	Maximum torsion	N·mm
□T	Torsion increment	N·mm
Φ	Torsion angle	(°)
Φ_{max}	Maximum non-proportional torsion angle	(°)
□Φ	Torsion angle increment	(°)
Ip	Polar moment of inertia	mm^4
W	Section factor	mm^3
G	Shear modulus	MPa
τ_p	Proof strength of non-proportional torsion	MPa
τ_{eH}	Upper yield strength	MPa
τ_{eL}	Lower yield strength	MPa
τ_m	Torsional strength	MPa
γ_p	Non-proportional shear strain	%
γ_{max}	Maximum non-proportional shear strain	%
π	Ratio of circumference	

5 Sample

5.1 Sample shape and size

5.1.1 Cylindrical sample

For the shape and size of the cylindrical sample, see Figure 1. The shape and size of the sample ends should be suitable for the collets of the testing machine to be held. Samples with a diameter of 10mm, gauge lengths of 50mm and 100mm and parallel lengths of 70mm and 120mm respectively are recommended. If the sample with other diameter is used, its parallel length should be gauge length plus double diameters.

In millimeters

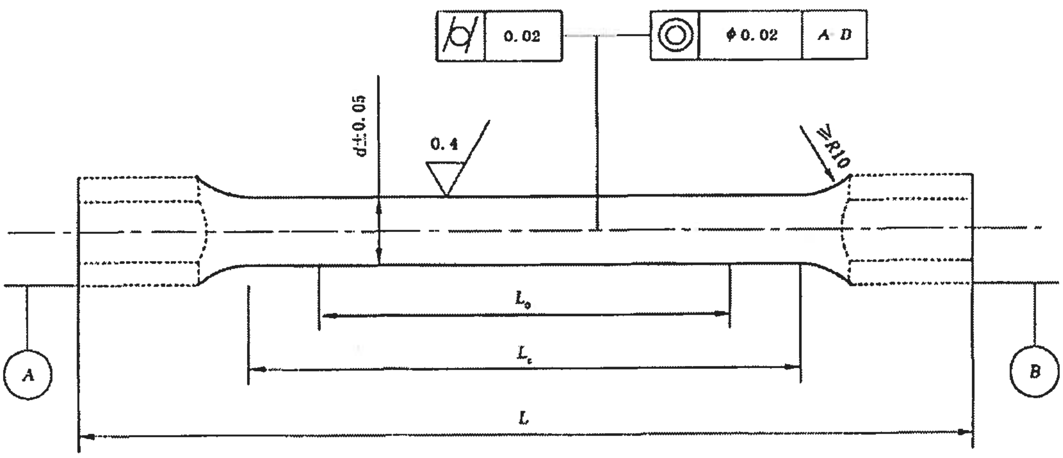
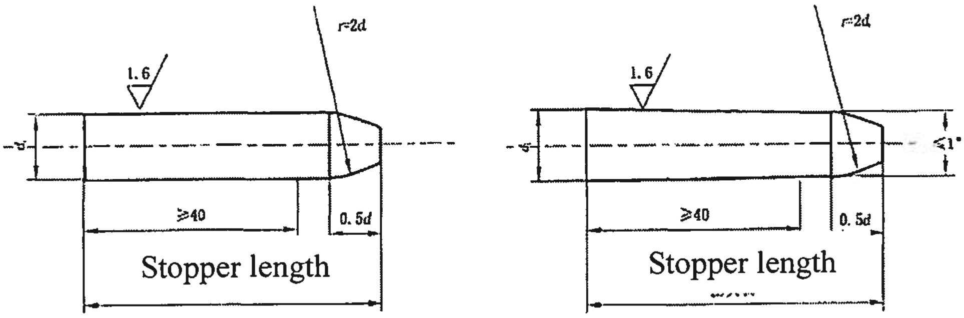


Figure 1. Cylindrical sample

In millimeters



Note: d_i is inside diameter of the cylindrical sample.

Figure 2. Stoppers of the cylindrical sample

5.1.2 Tubular sample

The parallel length of the tubular sample should be gauge length plus double outer diameters. The dimensional tolerances on its outer diameter and wall thickness and roughnesses on the inside and outer surfaces should comply with the requirements in related standards and agreements. The sample should be flat. Two ends of the sample should clearance fit the stopper. The stopper should not extend into its parallel length. For the shape and size of the stopper, see Figure 2.

5.2 Size measurement of the sample

5.2.1 Cylindrical sample

For the cylindrical sample, measure the diameter on the two ends of the gauge and its middle point in two vertical directions respectively and calculate their arithmetical average value. Use the above averages of the diameters measured on the three points to calculate the sample's polar moment of inertia. Use the minimum value among the above averages to calculate the section factor of the sample.

5.2.2 Tubular sample

For the tubular sample, measure the outer diameter in two vertical directions on its one end respectively and calculate their arithmetical average value. On the same end, measure the tube wall thickness in two vertical directions and calculate their arithmetical average value. Use the outer diameter averages and the wall thickness that measued to calculate the polar moment of inertia and the section factor of the sample.

5.2.3 Select the measuring equipments as shown in Table 2. The equipments should be calibrated regularly.

Table 2. Resolutions of measuring equipments

In millimeters

Sample size		Measuring equipment resolution
Diameter		0.01
Wall thickness	<1	0.002
	≥1	0.01
Gauge length		0.05

6 Testing devices

6.1 Testing machine

6.1.1 The testing machine should comply with the requirements of JJG 269.

6.1.2 In the test, one of the two collets of the testing machine should be able to move axially freely and no additional axial force on the sample. Two collets should be kept coaxial.

6.1.3 The testing machine should be able to load torsion continuously on the sample, without impact or vibration.

6.1.4 It should have good reading stability and can keep the torsion constant within 30s.

6.1.5 The testing machine should be calibrated regularly.

6.2 Torsion meter

Varied types of torsion meters are allowed to measure the torsion angle. However, they should satisfy the following requirements:

6.2.1 The relative error of the gauge lengths of the torsion meter should be not more than ±0.5%. The torsion meter should be installed on the sample firmly and does not slip during the test;

6.2.2 The resolution of the torsion angle indications is: ≤0.001°;

6.2.3 The relative error of the torsion angle indications is: ±1.0% (in the range of ≤0.5°, the indication error is ≤0.005°);

6.2.4 The repeatability of the torsion angle indications is: ≤1.0%;

6.2.5 The torsion meter should be calibrated regularly according to GB/T 12160.

7 Testing conditions

7.1 Normally, the test is done at the ambient temperature of 10-35℃. For the tests with the strict temperature requirements, the testing temperature should be 23±5℃.

7.2 Torsion velocity: it should be in the range of 3°/min-30°/min prior to the yield, not more than 720°/min after the yield. The velocity change should have no impact.

8 Performance measurements

8.1 Shear modulus measurement

8.1.1 Graphic treatment: record the torsion-torsion angle curve by the auto-recording method. Read the torsion increment and the corresponding torsion angle increment in the elastic linear portion of the recorded curve, see Figure 3. The shear modulus is calculated via Formula (1).

$$G=\frac{\Delta T L_e}{\Delta\phi I_p} \qquad \cdots\cdots(1)$$

Where the polar moment of inertia *Ip* is:

For cylindrical samples,

$$I_p=\frac{\pi d^4}{32} \qquad \cdots\cdots(2)$$

For tubular samples,

$$I_p=\frac{\pi d^3 a}{4}\left[1-\frac{3a}{d}+\frac{4a^2}{d^2}-\frac{2a^3}{d^3}\right] \qquad \cdots\cdots(3)$$

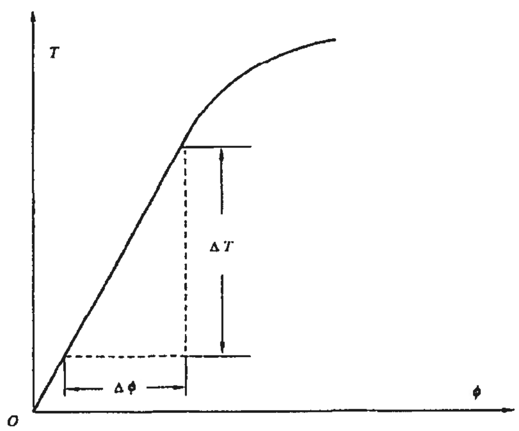


Figure 3. Shear modulus

8.1.2 Stage-by-stage loading method: To load the pre-torsion on the sample. The pre-torsion should not exceed 10% of the proof non-proportional torsional strength $\tau_{p0.015}$ for the corresponding prolepsis generally. Install the torsion meter and adjust its zero point. Load the sample with the torsion not less than 5 stages within the range of the elastic linear portion. Record the torsion of each stage and the corresponding torsion angle. The time to read each data pair should better not exceed 10s. Calculate the average torsion angle increment of each stage. And calculate the shear modulus via Formula (1). For measurement example, see Annex A.

Note: The least squares method is allowed to calculate the shear modulus by using data pair fitting of a straight line.

8.1.3 When this performance is obtained by auto-measuring system, the torsion-torsion angle curve may not be drawn.

8.2 Measurement of proof non-proportional torsional strength

8.2.1 Graphic treatment: record the torsion-torsion angle curve using the auto-recording method, see Figure 4. In the recorded curve, extend the elastic linear portion to the axle of torsion angle at the point O, intercept the OC portion ($OC=2L_e\gamma_p/d$), and draw the parallel CA of the elastic linear portion passing the point C and cross the curve at the point A. The torsion corresponding to the point A is the demanded torsion *Tp*. Calculate the proof non-proportional torsional strength via Formula (4).

$$\tau_p = \frac{T_p}{W} \qquad \text{......(4)}$$

Where the section factor W is:

For cylindrical samples,

$$W = \frac{\pi d^3}{16} \qquad \text{......(5)}$$

For tubular samples,

$$W = \frac{\pi d^2 a}{2}\left[1 - \frac{3a}{d} + \frac{4a^2}{d^2} - \frac{2a^3}{d^3}\right] \qquad \text{......(6)}$$

Note: For using graphic treatment to measure the true proof strength of non-proportional torsion, refer to Annex B.

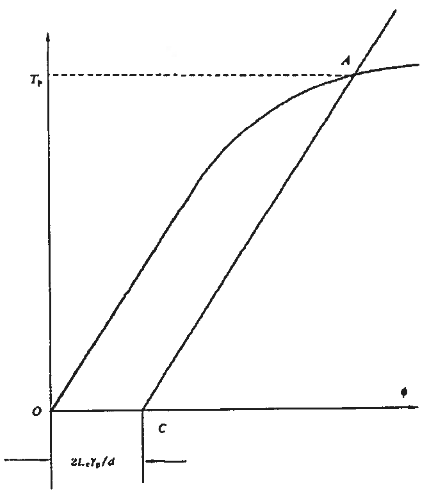


Figure 4. Proof strength of non-proportional torsion

8.2.2 Stage-by-stage loading method: After loading the pre-torsion on the sample according to Item 8.1.2, install the torsion meter and adjust its zero point. Load large-stage torsion before the strength equals to 70-80% of the proof strength of non-proportional torsion $\tau_{p0.015}$, and then load small-stage torsion. The small-stage torsion should equal to the shear stress increment not more than 10 MPa. Read the torsion of each stage and the corresponding torsion angle. The time to read each data pair should better not exceed 10s.

subtracting the torsion angle of elastic portion obtained after calculation from the torsion angle reading of each stage torsion, you will obtain the torsion angle of non-proportional portion. Load the torsion until the obtained non-proportional torsion angle equals to or slightly exceeds the specified value. Calculate the precise torsion using the interpolation method. Calculate the proof strength of non-proportional torsion via Formula (4). For measurement example, see Annex C.

8.2.3 When this performance is obtained using the auto-measuring system, the torsion-torsion angle curve may not be drawn.

8.3 Measurement of upper yield strength and lower yield strength

Measure them by graphic treatment or pointer method. For the arbitration test, graphic treatment is used. Record the torsion curve (torsion –torsion angle curve or torsion – collet torsion angle curve) by the auto-recording method or directly observe the indication of the torsion panel pointer of the testing machine in the test.

When this performance is obtained using the auto-measuring system, the torsion-torsion angle curve may not be drawn.

The maximum torsion prior to first drop is upper yield torsion and the minimum torsion not considering initial transient effect during the yield period is lower yield torsion, see Figure 5. Calculate upper yield strength and lower yield strength via Formulas (7) and (8) respectively.

$$\tau_{eH} = \frac{T_{eH}}{W} \quad \cdots\cdots (7)$$

$$\tau_{eL} = \frac{T_{eL}}{W} \quad \cdots\cdots (8)$$

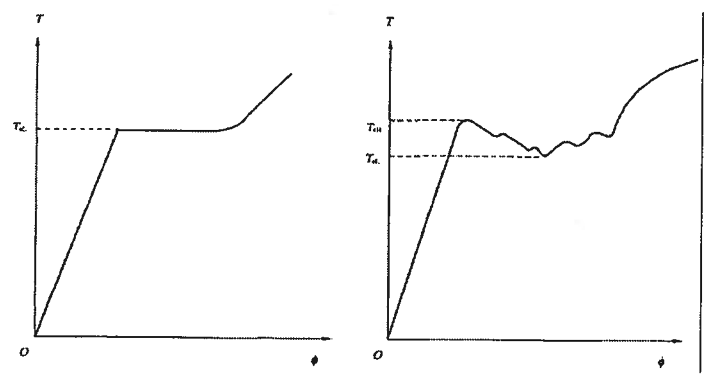


Figure 5. Upper and lower yield strength

8.4 Measurement of torsional strength

Load the torsion continuously on the sample until it is twisted off. Read the endured maximum torsion before the sample is twisted off on the recorded torsion curve (torsion –torsion angle curve or torsion –collet torsion angle curve) or from the torsion panel of the testing machine, see Figure 6. Calculate the torsional strength via Formula (9).

When this performance is obtained using the auto-measuring system, the torsion-torsion angle curve may not be drawn.

$$\tau_m = \frac{T_m}{W} \quad \cdots\cdots (9)$$

Note: For using graphic treatment to measure the true torsional strength, refer to Annex B.

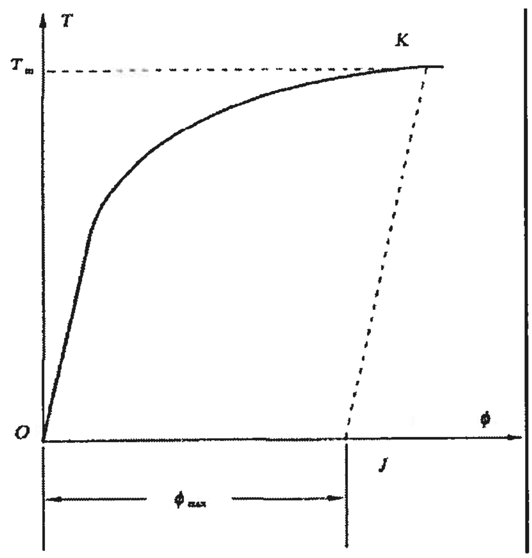


Figure 6. Torsional strength

8.5 Measurement of maximum non-proportional shear strain

Load the torsion continuously on the sample until it is twisted off and record the torsion-torsion angle curve during the test. Draw a parallel KJ of the elastic linear portion on the curve passing the breakpoint K and cross the axle of torsion angle at the point J. Thus OJ is the maximum non-proportional torsion angle, see Figure 6. Calculate the maximum non-proportional shear strain via Formula (10).

$$\gamma_{max}(\%) = \left(\frac{\phi_{max} d}{2L_e}\right) \times 100\% \quad \cdots\cdots (10)$$

9 Rounding off of the measured performance values

Round off the measured performance values as required in Table 3. The method of rounding off is defined according to GB/T 8170.

Table 3. Rounding-off intervals of performance results

Torsion performance	Range	Rounded off to
G	-	100 MPa
τ_p、τ_{eH}、τ_{eL}、τ_m	≤200 MPa	1 MPa
	>200 Mpa-1000 MPa	5 MPa
	>1000 MPa	10 MPa
γ_{max}	-	0.5%

10 Test report

Generally, the test report should contain the following information:

a) National standard reference number;

b) Description of sample features;

c) Sample no. and size;

d) Measured results of each performance;

e) Date.

Annex A
(Informative)
Example of using the stage-by-stage loading method to measure the shear modulus

Material to be tested: titanium alloy Client:

Sample size: d=10.00mm Sample No.:

Torsion meter gauge length: L_e=100.0mm Torsion meter type: mirror style meter

Distance from mirror face to the gauge: s=1000mm

Polar moment of inertia: Ip=981.75mm^4

Table A.1

Torsion T/ (N·mm)	Torsion increment □T/(N·mm)	Gauge reading/mm		Reading increment/mm		Reading difference/mm	Average reading difference/mm
		l_{left}	l_{right}	l_{left}	l_{right}	Δl_{left}-Δl_{right}	Δl
10000	5000	0	0	-	-	-	-
15000	5000	24	5	24	5	19	
20000	5000	50	10	26	5	21	
25000	5000	74	15	24	5	19	
30000	5000	99	20	25	5	20	20.1
35000	5000	125	25	26	5	21	
40000	5000	151	30	26	5	21	
45000	5000	176	35	25	5	20	

$$G=\frac{\Delta T\cdot L_e}{\Delta\phi\cdot I_p}=\frac{\Delta T\cdot L_e}{\frac{1}{2}\left(\frac{\Delta l}{s}\right)\cdot I_p}=\frac{5\,000\times 100\times 2\,000}{20.1\times 981.75}=50\,676.08\ \text{MPa} \quad \cdots\cdots(\text{A.1})$$

Rounded off to: G=5.07×10^{4}MPa.

Annex B
(Informative)
Measurement methods of true proof strength of non-proportional torsion and true torsional strength

B.1 Scope

This annex applies to the measurements of the true proof strength of non-proportional torsion and the true torsional strength of cylindrical samples in metal material.

B.2 Terms and definitions

B.2.1 True proof strength of non-proportional torsion

τ_{tp}

Is the shear stress calculated via Nadai's Formula when the non-proportional shear strain on the outer surface of the gauge length portion on the cylindrical sample reaches the specified value during the torsion test.

Note: The symbol that represents this stress should be indicated using footnotes, for example, $\tau_{tp0.015}$ and $\tau_{tp0.3}$ represents the true shear stress when the proof non-proportional shear strain reaches 0.015% and 0.3% respectively.

B.2.2 True torsional strength

τ_{tm}

Is the maximum shear stress calculated via Nadai's Formula when the cylindrical sample is twisted off during the torsion test.

B.3 Samples, test equipments and test conditions

The requirements for samples, test equipments and test conditions are identical with the requirements in Chapter 5, 6 and 7 in this standard respectively.

B.4 Measurement methods

B.4.1 Using graphic treatment to measure the true proof strength of non-proportional torsion

After recording the torsion –torsion angle curve according to Item 8.2.1 and drawing the parallel to determine the intersection point A, draw the tangent AT_1 of the curve with Point A as the tangency point and cross the torsion axle at T_1, see Figure B.1. Read Torsions T_A and T_1 at Point A. Calculate the true proof strength of non-proportional torsion via Formula (B.1).

$$\tau_{tp} = \frac{4}{\pi d^3}\left[3T_A + \theta_A\left(\frac{dT}{d\theta}\right)_A\right] = \frac{4}{\pi d^3}[4T_A - T_1] \quad \text{(B.1)}$$

Note: In the formula, θ is the relative torsion angle, and $\theta = \Phi/L_e$.

When this performance is obtained using the auto-measuring system, the torsion-torsion angle curve may not be drawn.

B.4.2 Using graphic treatment to measure the true torsional strength

$$\tau_{tm} = \frac{4}{\pi d^3}\left[3T_K + \theta_K\left(\frac{dT}{d\theta}\right)_K\right] = \frac{4}{\pi d^3}(4T_K - T_B) \quad \text{(B.2)}$$

Record the torsion-torsion angle curve by using the auto-recording method until the sample is twisted off. Draw the tangent KT_B of the curve with the breakpoint K on the curve as the tangency point and cross the torsion axle at T_B, see Figure B.2. Read Torsions T_K and T_B at Point K. Calculate the true torsional strength via Formula (B.2).

When this performance is obtained by using the auto-measuring system, the torsion-torsion angle curve may not be drawn.

Note: In the formula, θ is the relative torsion angle, and $\theta = \Phi/L_e$.

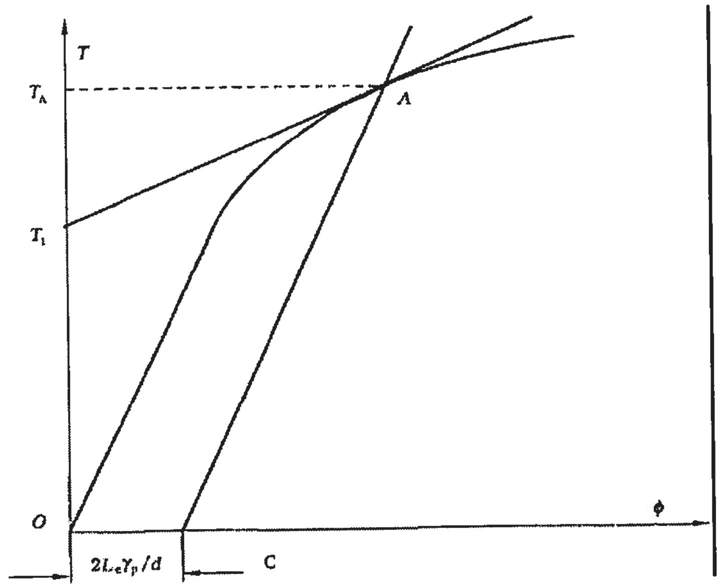


Figure B.1 True proof strength of non-proportional torsion

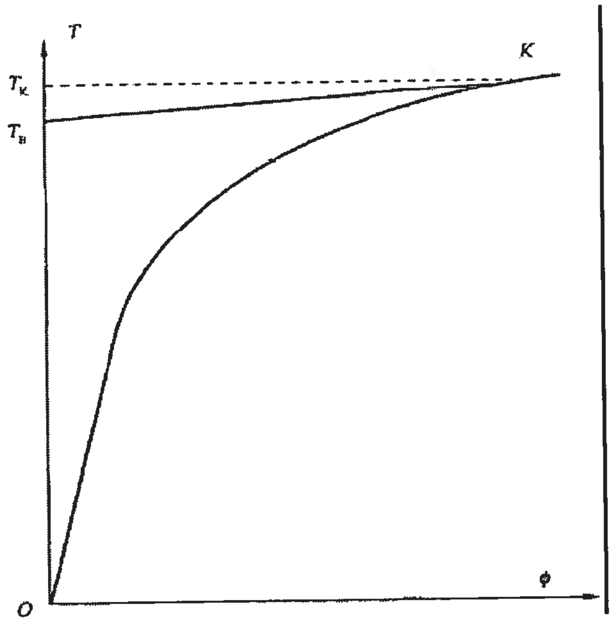


Figure B.2 True torsional strength

B.5

The values for measured results of the true proof strength of non-proportional torsion τ_{tp} and the true torsional strength τ_{tm} should be rounded off to 1MPa.

Annex C
(Informative)
Example of using the stage-by-stage loading method to measure the proof strength of non-proportional torsion $\tau_{p0.015}$

Material to be tested: Carbon steel.

Sample size: d=10.00mm.

Torsion meter gauge length: L_e=100.0mm.

Torsion meter graduate:0.00025 rad.

Section factor: W=196.35mm^3.

Proleptic proof strength of non-proportional torsion $\tau_{p0.015}$=250MPa.

Adopt the initial prestress $\tau_o=10\%\ \tau_{p0.015}=25$ MPa, equalling to the pretorsion $T_o=\tau_o\cdot W-4\ 908$(N·mm), round it to the integer part T_o-5000(N·mm).

The torsion equalling to 80% of proleptic proof strength of non-proportional torsion is:

$T=80\%\ \tau_{p0.015}W=80\times250\times196.35/100=39\ 270$(N·mm), round it to the integer part T=39000(N·mm).

Load large-stage torsion prior to 80% of the proleptic proof strength of non-proportional torsion and then load small-stage torsion. Large-stage torsion adopts three stages, each stage is

$$\Delta T=\frac{T-T_o}{3}=\frac{39\ 000-5\ 000}{3}=11\ 333(\text{N}\cdot\text{mm})$$

Round it to the integer part $\Delta T=11\ 000$(N·mm) .

Small-stage torsion adopts $\Delta T_1=2\ 000$(N·mm).

For test records, see Table C.1.

Table C.1 Test records

Torsion T/(N·mm)	Reading graduate of torsion meter	Reading increment graduate	Calculated proportional torsion angle reading graduate	Calculated non-proportional torsion angle reading graduate
5000	0	0		-
16000	53	53		-
27000	109	56		-
38000	165	56		-
40000	174	9	$\Delta A_{2\,000}=10.3$	-
42000	186	12		-
44000	197	11		-
46000	207	10		-
48000	219	12		-
50000	232	13		-
52000	249	17	242.3	6.7
54000	270	21	252.6	17.4
56000	296	26	262.9	33.1

The average torsion angle increment of small-stage torsion obtained from calculation within the range of linear proportions is:

$$\Delta A_{2\,000} = \frac{232-0}{50\,000-5\,000} \times 2\,000 = 10.3$$ graduates

Subtracting the proportional torsion angle calculated according to the proportional torsion angle of 10.3 graduates corresponding to each 2000 (N·mm) from the total angle reading, you will get the non-proportional torsion angle.

For the proof strength of non-proportional torsion $\tau_{p0.015}$ to be measured, its specified non-proportional shear strain is 0.015%, and the corresponding graduate number on the torsion meter is:

$$\left(2 \times 0.015\% \times \frac{L_e}{d_o}\right)/0.000\,25 = \left(2 \times \frac{0.015}{100} \times \frac{100.0}{10.00}\right)/0.000\,25 = 12.0$$ graduates

The corresponding torsion when the nearest non-proportional torsion angle of 12.0 graduates is read from Table C.1 is 52000 (N·mm), the precise torsion calculated via the interpolation method is:

$$T_{p0.015} = \frac{(17.4-12.0) \times 52\,000 + (12.0-6.7) \times 54\,000}{(17.4-6.7)} = 52\,990.65 \text{ MPa}$$

Then it gives:

$$\tau_{p0.015} = \frac{T_{p0.015}}{W} = \frac{52\,990.65}{196.35} = 269.879 \text{ MPa}$$

Rounded off to:

$\tau_{p0.015} = 270$ MPa

References

GB/T 12160 Calibration of extensometers used in uniaxial testing (GB/T 12160-2002, ISO 9513:1999, IDT)

Preface

This criterion can replace GB/T 10128---1988 *Metallic Torsion Test at Ambient Temperature*. Comparing with this kind of test, it has the following changes:

— It deletes the previous quoted standard GB 6397 *Metal Tensile Test Samples* and adds GB/T 10623 *Mechanics Property Test Terminology of Metal Material,* JJG 269 *Torsional Testing Machine;*

— In the chapter of "terminology, sign", the terminologies are re-writed according to GB/T 1.1---2000, changing the "yield point" into "yield strength", "upper yield point" into "upper yield strength", "lower yield point" into "lower yield strength". The sign of "$\tau_p|$" is deleted in the previous table 1.

— In chapter 5, "table 2 tubular samples plug" is added.

— The requirement of torsion meter is changed.

— Having changed the speed of torsion

— The measurement of yield point, upper yield point and lower yield point is changed into "the measurement of upper yield strength and lower yield strength", at the same time, the formula (7) in GB/T 10128-1988 is deleted.

— The content of auto mechanism measurement is added in the property measurement.

— The formula (11) in GB/T10128-1988 is changed.

— The Rounding off Numerical Values is changed into rounding off segmentations.

— The content of test report is given more details.

Appendixes A, B, C of this criterion are informative annex.

This criterion is proposed by China Iron &Steel Association.

This criterion is under the centralized management by National Steel Standardization Technology Committee.

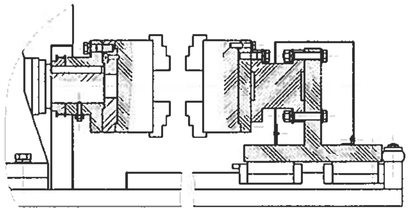
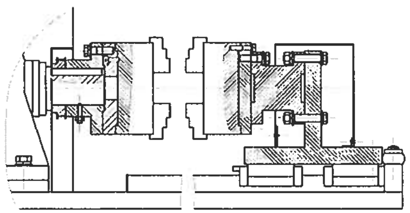
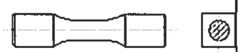
This criterion is drafted by CISRI, Shenzhen Xinsansi Material Detector CO. LTD., Metallurgical Industry Information Standardization Research Institution, Jinan Time Assaying Instrument Co., Ltd.

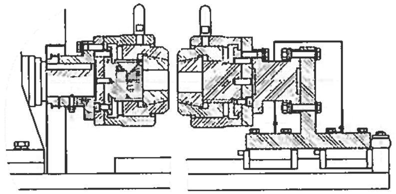
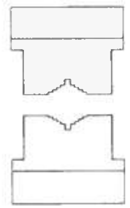
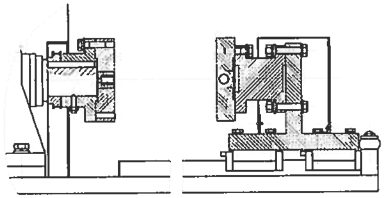
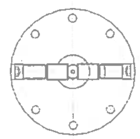
This criterion is drafted by Zhao Junping, Gao Yifei , An Jianping, Dong Li, Lu Jianzhou.

The situation of former version replaced by this criterion is:

— GB/T 10128---1988

TNS-DW Grip

code	Model	Name	drawing	parameters	Specimen's shape	Section drawing of specimen	note
1	TNS-DW-F01	Scroll chuck		1) Max.torque＜100Nm 2) Max.hardness of specimen ＜20HRC 3) Specimen's diameter Φ6~Φ32mm	Section area for Round specimen		Diameter 160mm clamping
				1) Max.torque: it is done as per machine's max. 2) diameter of round section area: Φ6~Φ25mm	Two side of specimen like triangle, hexagon, round section area in the middle of specimen		
2	TNS-DW-F02	Four-jaw chuck		1) Max.torque＜100Nm 2) Max.hardness of specimen ＜20HRC 3) Diameter of specimen Φ6~Φ32mm	Section area for Round specimen		Diameter 160mm clamping
				1) Max.torque: it is done as per machine's max. 2) diameter of round section area: Φ6~Φ25mm	Two side of specimen like quadrangle, octagon, round section area in the middle of specimen		

3	TNS-DW-F03	V type adjusted clamping		1) Max.torque<100Nm 2) Max.hardness of specimen <20HRC 3) Diameter of specimen Φ6~Φ25mm	Section area for Round specimen		 clamping drawing
				1) Max.torque: it is done as per machine's max. 2) diameter of round section area: Φ6~Φ16mm	Two side of specimen like hexagon, round section area in the middle of specimen		
4	TNS-DW-F04	Flat-nose opposite clamping		1) Max.torque<100Nm 2) Max.hardness of specimen <20HRC 3) Diameter of specimen Φ6~Φ25mm	Two side of specimen is flat, round section area in the middle of specimen		 clamping drawing

Note: They are all special clamping, cost $300/set.

Thanks for choosing our TNS-W500 Computer Controlled Torsion Testing Machine. Prior to operation of the machine, read carefully “Operation Instruction” and “User Manual of the Control System of Static-torque Tester”, and start the machine after fully understanding. Keep the machine well and use properly to obtain high precise and good running status

1 Main purpose and usage range

This machine is designed to test the turning of metal, nonmetal and compound materials, and it can measure the torque and angle of distortion (Moreover, as equipped with corresponding accessories, it can be used to perform torsion resistant testing and shear modulus G testing for parts and components). The machine meets the testing requirements of GB10128-88 "Metallic materials--Torsion test at room temperature". All the operation of the test can be performed via the testing application installed in the tester, so as to realize the automatic acquisition, storage, processing and display of the testing data, and the test result can be printed out.

2 Key specification, technical parameter and index

No.	Item	Specification, parameter and index
1	Max Testing Torque $M_N(N\cdot m)$	500
2	Precise Torque Range($\pm(N\cdot m)$)	10～500
3	Relative Torque Reading Error	±1.0%
4	Repetitive Relative Torque Reading Error	≤1.0%
5	Min Reading of Distortion Angle(°)	0.1
6	Range of Testing Speed (°/min)	0.1～720
7	Dia. Of Specimen (mm)	Φ8～Φ25
8	Test space of the tester (mm)	0～600
9	Testing Direction	Bi-direction
10	Power of the Motor (kW)	0.75
11	Working Voltage (V)	AC 220±10% 50Hz

3 Working conditions

The tester can operate normally under following conditions:

a) Room temperature: 10~35 □;

b) Relative humidity≤80%;

c) Positioned steady;

d) Clean environment free of vibration, corrosive medium or strong electromagnetic interference (EMI);

e) The fluctuation of the power supply is limited within ±10% of the rating voltage.

4 Structural characteristic and working principle

The tester comprises of mechanics, electrics and PC.

4.1 Structure of the main body and working principle (See diagram of outline)

The driven chuck is equipped on the torque sensor, and it can be moved along the line guide. The turning specimen is installed between the two chucks, and the driving chuck will rotate following the rotation of the reduction gear which is driven by the servo motor. Both manual and automatic test with load is applicable.

4.2 Electrics and PC

The electric component comprises of tow system and measurement/control system. The PC can perform various control, display, data acquisition and processing, plot of curve, storage of test result, and real display of test curve.

5 Installation and adjustment

5.1Take the tester out of the package, check for any shock or damage resulting from the transportation;

5.2 Install the adjustment block for the bed to make the worktable level;
5.3 Power supply shall be 220V AC/50Hz;
5.4 The tester shall be grounded reliably for safety of personnel.

6 Usage and operation

6.1 Switch on the air switch of the power supply;
6.2 Switch on the PC and enter the torque test screen;
6.3 Push the servo start button on the manual control box to start the servo control system. After the test speed is selected via the PC, push the forward/backward rotation button to keep the driving chuck rotation (the anticlockwise rotation of the chuck is deemed as forward rotation, and the clockwise rotation is deemed as backward rotation). The test can begin after the specimen is installed.

In case of abnormity during the test, push the red emergency stop button to stop, rotate the emergency stop button clockwise to release the emergency stop. Take down the specimen after unloading;

6.4 Installation of torsion extensometer (that is an optional parts, see the instructionin the torsion meter box for detailed operation)

Select the copper half corresponding to the electric torsion extensometer based on the Dia. Of the specimen, adjust the two pins to make the clearance of the two semi-circular surfaces of the torsion extensometer within 0.5mm. Put the half whose blade is equipped with long bar on the end of the driven chuck as installation of the torsion extensometer. Define the standard test gauge length by means of the standard gauge length block, and make the distance between the two blades of the electric torsion extensometer about 6mm, keep the two blades downward and tighten the secutiry screw, and then mount the tension extensometer.

Precaution: During the usage of the torsion extensometer, dismount/re-assemble the torsion meter as powered off. Pay special attention to the permitted turning direction of the torsion meter, it is only allowed to increase the distance between the two blades of the torsion extensometer (backwards) during test to avoid any damage!

6.4 For operation of the application, refer to "User Manual of the Control System of Static-torque Tester".

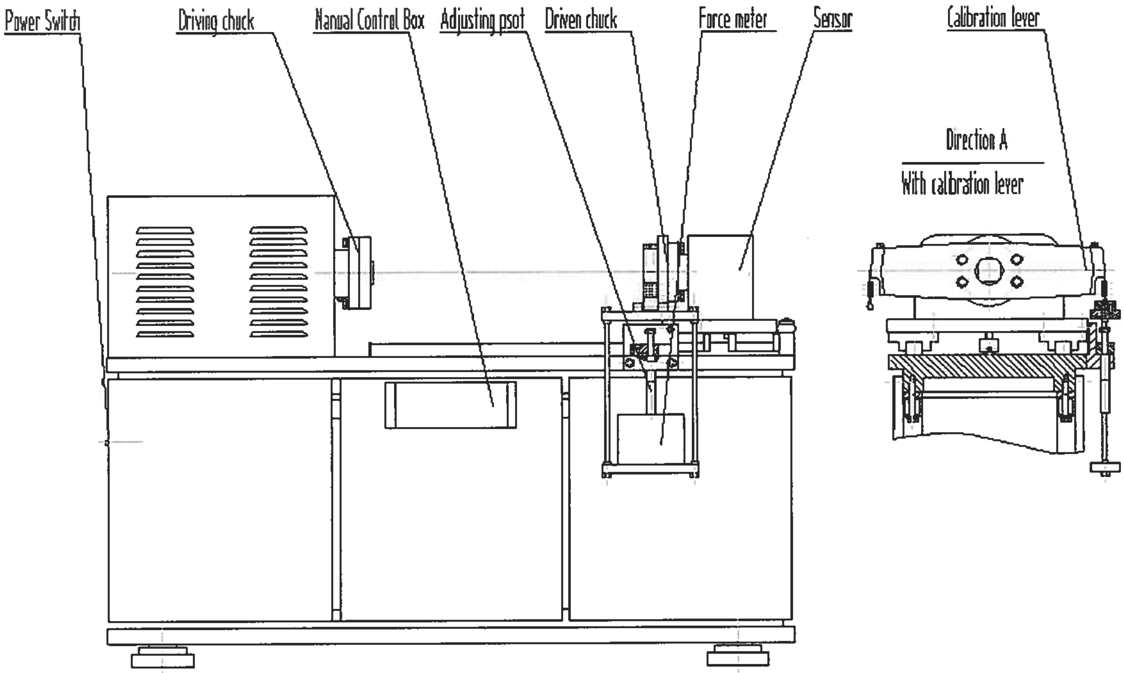
7 Calibration of the torque

7.1 Align the driven chuck bore with the flare block. Install the upper surface of the calibration lever on the driven chuck horizontally, and install the accompanying frame, put the standard force gauge in the hanging plate for calibration (Weight is optional for small range).
7.2 The tester shall be calibrated at least every year.

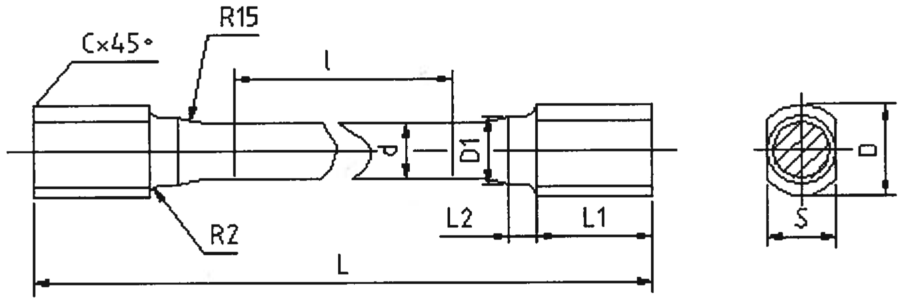
8 Maintenance and repair

8.1 Clean the guide and lubricate it prior to usage each time;
8.2 The lubricant for the reduction gear shall be EP gear oil for middle load L-CKC100 made in china. Fill in new oil after 2 weeks of running originally, and replace it every 3 to 6 months based on the practice.

9 Diagram of outline



10 Diagram of the specimen



d	D	D1	S	l	L1	L	r	c	L2
B-11	16	12	12	10d	20	l+60	2	1	5
12-17	24	1B	18	10d	20	l+70	2	2	10
18-25	32	27	24	10d	30	l+90	3	3	10